VOL. XII. NO. 6.—BOTANICAL GAZETTE.—JUNE, 1887.

The occurrence and function of certain nitrogenous bodies in plants.

W. E. STONE.

The nitrogenous bodies are probably the least understood of all plant constituents; indeed, the whole question of the relation of nitrogen to vegetation presents many unsolved problems. Its source, assimilation, various forms of existence, destruction, transformation and functions are all subjects of discussion at present, as they have been for many years. Something of the difficulty met with in the study of these questions arises from the chemical indifference of the element, and the difficulty of recognizing and isolating its various compounds as such. Micro-chemical methods fail for this purpose except in one or two cases, and, while purely chemical processes have accomplished a great deal, the discoveries announced from time to time, and the still existing gaps in theories, show that all the data are not yet at hand. A very practical and tangible illustration of this state of our knowledge occurs in the estimation and valuation of vegetable nitrogen as a food element. For lack of a better general knowledge and methods the total nitrogen present is regarded as existing in the form of albumin, or in a few cases is classified as albuminoid and non-albuminoid, although it is well known that it may be present in a variety of forms of very different value and structure. If these different nitrogenous bodies have different values to the animal system, it is quite certain that they represent different physiological offices and uses in the living vegetable organism.

During the past decade certain German investigators have done much toward determining (1) what these nitrogenous bodies are, and (2) what their functions may be. The results of their work, scattered through various chemical and botanical journals, are not generally available to American botanists, nor have they, so far as I know, been connectedly presented to them. For these reasons, no less than because it is a very important physiological subject, a general résumé has seemed desirable.

For the sake of convenience the vegetable nitrogenous bodies may be classified under two heads: those which play

the part of reserve material, and those which are involved in the vital processes of the germinating or growing plant, or, passive and active forms. The work of the past few years has pointed out the existence of these classes and indicated their different values in the vegetable economy.

The reserve nitrogenous bodies occur chiefly in the form of albumin, or according to Ritthausen[1] *conglutin* and *legumin*, terms commonly applied to vegetable albumin or casein. These compose almost exclusively the nitrogenous constituents of seeds, but in roots and tubers are often accompanied by other bodies of a secondary and derivative nature, which may be regarded as surplus untransformed materials left by the cessation of the vegetative processes. The albumins, legumin and conglutin, which may be regarded as the true reserve forms of nitrogen, are colloids, are insoluble in acid fluids and, usually existing in a solid condition, are not directly available for the processes of transmutation or assimilation.

The active or secondary forms, occurring rarely in seeds but always present in germinating and, at least locally, in growing plants, we will discuss more in detail. They are chiefly amido compounds, crystalloids, and soluble in fluids of the plant. Because of their unstability and great solubility, their isolation is very difficult; for a long time their existence was not recognized, and even at present it may be affirmed safely that still others await discovery.

The most common of these, and, because of its comparatively easy recognition, the first which attracted attention, is asparagin,[2] now regarded as a generally disseminated plant constituent and proved to be present in a large number of families.[3] It was found in the young germs of *Lupinus luteus* by Beyer,[4] and subsequent study showed that the seeds and germs of this plant were peculiarly adapted to the investigation of these secondary nitrogenous compounds. The 10 to 12 per cent. of nitrogen in the seeds is almost entirely in the form of albumin, unaccompanied by asparagin, while the germs are unusually rich in asparagin and other non-albuminous nitrogenous bodies.

Pfeffer[5] made this the subject of especial study, and found

[1] Die Eiweiss Körper der Getreidearten, p. 188.

[2] $C_4H_8N_2O_3$. Discovered by Vauquelin and Robiquet in asparagus shoots, in 1805.

[3] For a list of plants in which it had been found at that date, see Die Pflanzenstoffe, Berlin, 1871, A. & T. Husemann.

[4] Landwirthschaft. Versuchs-Stationen, vol. 9 (1867), p. 168.

[5] Pringsheim's Jahrbuch für Botanik, vol. 8 (1872), p. 429.

that if the germs were excluded from light the amount of asparagin formed was greatly increased, particularly in the last stages of germination. He concluded that the asparagin was derived from the albumin originally occurring in the seed, and served for the transportation of the same to the growing parts of the plant—a process analogous to the solution and transmutation of insoluble carbohydrates. His deductions were confined, however, to the Leguminosæ, outside of which he does not mention the occurrence of asparagin.

In 1876 E. Schulze[6] published the first of a notable series of contributions upon the subject. Lupine seeds which contained 45 per cent. of albumin were germinated and grown fifteen days under exclusion of light. At the end of this time the total amount of nitrogen present was unchanged, but only 8 per cent. of albumin remained; 37 per cent. had been changed to a soluble form, of which nearly two-thirds was asparagin. By repeated experiments it was found that the most favorable conditions for the formation and accumulation of asparagin were germination in the dark for ten days, and then exposure to faint light for some weeks[7]; the germs thus produced contained usually 27 to 28 per cent. of their dry weight in asparagin. The quantity produced was proportional to the time of growth, and it was found in the greatest abundance in the axial organs. These observations were supplemented by those of Borodin,[8] who gave to the question a new aspect by investigating the different parts of growing plants.

In the young shoots of many trees and shrubs he found appreciable quantities of asparagin; in some, however, only traces; while in others, as Larix, Betula, Alnus, Syringa, Lonicera, etc., none at all could be recognized. But by modifying the conditions, viz., by detaching the twigs and allowing the buds to develop in water at ordinary room temperature, he was able to produce asparagin in all of the many species examined. He concluded, with Pfeffer and Schulze, that it could only come from a breaking down of albumin, and that it probably served as a source for the regeneration of the latter at a later stage.

The study of the problem thus far had been prosecuted

[6] Berichte d. Deutschen Chem. Gesellschaft, vol. 9 (1876), p. 1314. Also Landwirthschaft. Jahrbücher, vol 5 (1876), p. 821.

[7] Journal für Practische Chemie, vol. 27 (1883), p. 337.

[8] Botanische Zeitung, vol. 36 (1878), p. 801.

chiefly by micro-chemical methods, with the result of establishing the general occurrence of asparagin, and the theory that it served as a transferring agent between reserve albumin and the vegetative organs of the plant. This theory lacked general application because in some cases asparagin could not be detected and in others occured in too small quantities to satisfy the requirements of the plant if the theory was true. Either the hypothesis was not correct or there must be other products of the breaking up of albumin which the methods thus far used could not detect.

The identification of such products by chemical methods not only supplied facts of the most vital importance to the question under consideration, but serves to illustrate the dependence of vegetable physiology upon the chemist as well as the microscopist for the solution of its problems.

Shortly before Borodin's investigations Schulze had taken up the study of the seeds and young germs of Cucurbita Pepo.[9] Pfeffer had not found asparagin here, but Sabanin and Laskowsky[10] had obtained secondary ammonia salts in watery extracts from them, without, however, determining their nature. Schulze, by a peculiar method of treatment, was able to isolate glutaminic acid, which was assumed to exist originally in the juices of the germ as an amide.[11] This amounted to 1.75 per cent. of the dried weight of the germs, which were grown sixteen days under exclusion of light. As no such substance occurred in the ungerminated seeds he concluded that like the asparagin of the lupine it was derived from the breaking down of albumin, and performed a similar office to the plant. Later[12] traces of asparagin were found together with small quantities of tyrosin and leucin,[13] all secondary, soluble, nitrogenous bodies, to which were subsequently added vernin,[14] xanthin bodies, ammonia salts and nitrates.[15]

Meanwhile the lupine which had produced asparagin so freely, had also been examined for other nitrogenous bodies, with rich results.[16] Beside the small quantities of glutamin, leucin, tyrosin, and possibly ammonia salts, which it pro-

[9] Berichte d. Deutschen Chemischen Gesellschaft, vol. 10 (1877), p. 199.
[10] Landwirthschaft. Versuchs-Stationen, vol. 18, p. 405.
[11] Probably as $C_5H_6(NH_2)_2O_3$.
[12] Journal für Practische Chemie, vol. 20, p. 385.
[13] Tyrosin=$C_9H_9(NH_2)O_3$. Leucin=$C_6H_{11}(NH_2)O_2$.
[14] Vernin=$C_{16}H_{20}N_2O_2$. See Zeitschrift für Phisiolog. Chem., vol. 10, p. 80.
[15] Journal für Practische Chemie, vol. 32, p. 433.
[16] Journal für Practische Chemie, vol. 27, p. 337.

duced in common with Cucurbita, two *amido* acids[17] and peptone were found; while during the last year it has yielded still another new body, arginin.[18]

These substances are all regarded as secondary products derived from the albumin of the seed in a manner analogous to the formation of asparagin. Confirmatory of this view is the fact that the albumin of lupine seeds when subjected to artificial chemical action is converted into amido acids which seem to be identical with those produced in germination.[19]

It was noteworthy that the amido acids which were so distinctly present in the germs of lupine were not found in those of Cucurbita, and that the asparagin of the former was substituted by glutamin in the latter.

Following Borodin's study of the occurrence of asparagin in the young shoots of woody plants, Schulze conceived that other bodies might be found here as well as in the germinating stages already examined. Twigs of Platanus occidentalis were removed from the tree in April and kept in a warm room until no further growth was made. The young shoots thus developed contained, besides asparagin, an appreciable quantity (.5 to 1 per cent.) of a substance corresponding in its reactions to allantoin.[20] Repeated investigations showed this to be a constant constituent of young shoots of Platanus treated in this way, but it could not be detected in shoots or leaves growing normally upon the tree. Leucin and bodies of the xanthin group were also found in Platanus. Allantoin also occurs in the shoots of Acer pseudo-platanus.

The vernin, already mentioned in connection with lupine, seems also to be widely disseminated, occurring in the germs of Vicia sativa (in which it was discovered), Trifolium pratense, Cucurbita Pepo, the sclerotium of Claviceps purpurea, and the pollen of Pinus sylvestris and Corylus avellana.[21]

The examples given show that in the germinating and vegetative stages of the plant, secondary nitrogenous bodies appear in considerable variety of form, and in sufficient quantities to imply some important use or office. The idea that nitrogenous, and particularly albuminous, substances undergo changes during growth and assimilation is by no means

[17] Phenyl-amido-propionic acid=$C_9H_9(NH_2)O_2$. Amido-valerianic acid $C_5H_9(NH_2)O_2$.

[18] $C_6H_{14}N_4O_2,HNO_3+\frac{1}{2}H_2O$. See Berichte d. Deutsch. Chem. Gesellsch., vol. 19 (1886), p. 1177.

[19] Schulze Zeitschrift für Physiol. Chem., vol. 9, p. 63; same vol., p. 253: vol. 10, p. 134; vol. 11, p. 210. Also Gorup-Besanez, Berichte d. Deutsch. Chem. Gesellsch., vol. 10, p. 780.

[20] $C_4H_6N_4O_3$. Berichte d. Deutschen. Chem. Gesellschaft, vol. 14 (1881), p. 1602.

[21] A. von Planta. Landwirthschaft, Versuchs-Stationen, vol. 31, p. 97, and vol. 32, p. 215.

new. Liebig regarded these bodies as possessing the nature of ferments,[22] but Hartig first indicated the probable breaking up of reserve albumin into crystallenic compounds.[23] Pfeffer in his thorough discussion of the appearance of asparagin, already referred to, ascribed its origin to the original albumin present, and pointed out that in the change C and H were set free, either to be exhaled or adapted to the building of new tissue.[24]

The exclusion of light favored its formation, but he afterwards found that the process followed equally well in the light if CO_2 was excluded. This led him to conclude that the formation of asparagin was in some way connected with the presence or absence of carbohydrates in the plant. Borodin found it accumulating in young shoots and buds not alone when detached from the parent stem, but equally as well when, remaining in position, they were protected from light. He also concluded that the phenomenon was caused by the lack of non-nitrogenous substances, based upon one of two principles, either, first, albumin undergoes no breaking down in the presence of carbohydrates; or, second, it constantly undergoes transformation, but in the presence of carbohydrates is constantly regenerated to new albumin, and no accumulation of the secondary products takes place.[25]

The latter supposition seemed the more probable, since the asparagin which collected in etiolated growths disappeared again when they were exposed to light, and albumin increased proportionally.

Schulze's discovery of so many other bodies homologous to asparagin, served to strengthen and broaden the application of the theory of the transformation of albumin. He showed farther that in the germs where the secondary products accumulated, there was an increase of H_2SO_4 corresponding to the amount of S set free from the broken down albumin molecules,[26] and Pfeffer regards the exhaled CO_2 as also coming from this source.[27]

The dependence of these bodies upon the absence of nitrogen-free substances for their formation seems also clearly indicated by the observations upon etiolated growths, and

[22] Die Organische Chemie in ihrer Anwendung auf Agricultur, 1840, p. 220.

[23] Entwickelungs-Geschichte der Pflanzen-Keim, 1858, p. 126.

[24] Botanische Zeitung, vol. 8 (1872), p. 429. See also Physiological Botany, Goodale, p. 365.

[25] Botanische Zeitung, vol. 36 (1878), p. 801.

[26] Berichte d. Deutschen Chem. Gesellschaft, vol. 9 (1876), p. 1314; vol. 11 (1878), p. 438; vol. 13 (1880), p. 21.

[27] Handbuch der Pflanzenphysiologie, p. 295.

the effect of withholding CO_2. Farther Schulze has shown[28] that those seeds containing proportionally large amounts of albumin and small quantities of carbohydrates, produce amide compounds most abundantly in germination. The ratios of albumin to nitrogen-free substances in seeds of lupine and Cucurbita were respectively 1 : 0.35 and 1 : 1.56. After fifteen days' germination, the lupine produced 19.43 per cent. of the dry weight of the seeds in asparagin and glutamin, and Cucurbita only 5.78 per cent.

The office of the vegetable amides is, therefore, as at present understood, to serve as a transferable form of nitrogen from reserve supplies to the place of growth, and farther, probably, as an indirect source of non-nitrogenous materials. Schulze has shown that they may also act as reserve material, in certain cases, in roots and tubers.[29] They occur universally in the germinating and vegetating stages of the plant, but fail almost as invariably in seeds. By their formation, through the breaking up of the albumin molecule, C and H are liberated, which may assist in the formation of new tissues, especially when assimilation has been artificially prevented or before it has begun in the germ. A like checking of assimilation in growing shoots, or a cutting off of the supply of nitrogen-free materials from the main stem, also results in an accumulation of these bodies. The small quantity of amides, formed by normal germination, is regenerated to albumin as soon as assimilation begins, while in the normal growth of plants they are found only sparingly, and in some cases not at all, or at least are not detected by our present methods. So much has been determined with reasonable certainty in our knowledge of these substances.

There remains the question whether the amides serve ordinarily for the transfer of nitrogen alone, while their ability to assist in the formation of carbohydrates is exerted only at stated periods or in emergencies, or whether these two processes are supplementary and constantly operating.

Pfeffer advances two hypotheses.[30] Either in every cell of growing tissue a transformation of albumin to amides is constantly occurring, and under normal conditions an equally constant regeneration to albumin follows, or such transformation occurs first when other nitrogen-free materials are

[28] Landwirthschaft-Jahrbücher, vol. 9 (1880), p. 733.

[29] Berichte d. Deutsch. Chem. Gesellschaft, vol. 16 (1883), p. 312; vol. 18 (1885), p. 390. Landwirth. Versuchs-Stationen, vol. 29, p. 295.

[30] Handbuch der Pflanzenphysiologie, p. 299.

lacking. Both may be true, and he points out the analogy of fungi which are able to make growth, forming cellulose and oils, with a nourishment of only nitrogenous substances, but if carbohydrates be also furnished them, a much smaller quantity of the nitrogenous matter will be made use of.

The principal amides observed under normal conditions, are, as already stated, asparagin and glutamin. Schulze assumes[31] that this does not indicate a larger production of these particular bodies, but that they are less easily regenerated than some other forms. In this way he explains the fact that the amount of asparagin in lupine germs continued to increase for some time after their exposure to light, at the same time assuming that the first carbohydrates formed by renewed assimilation are employed for the formation of new tissues, and not for the formation of albumin from amides.

The observations of Borodin and Schulze also indicate that not all carbohydrates or nitrogen-free substances have the properties for influencing the formation of amides or their regeneration. For instance, sugar beets contain considerable quantities of amides and cane sugar, existing side by side, and the conclusion is that cane sugar is unable to promote the regeneration of the amides or participate in the formation of new tissues. Fungi invert cane sugar before transmutation, and a similar process may be necessary before the regeneration of amides is possible. Probably only a few of the nitrogen-free bodies have this property; perhaps only glucose.

The question as to why the presence of nitrogen-free bodies is necessary to the regeneration of the amides also presents some difficulties. Since asparagin and glutamin contain less C and H than albumin, an addition of these elements is necessary to the formation of the latter. But tyrosin and leucin contain comparatively more C and H than albumin. Judging from their elementary composition, therefore, if one group requires the presence of carbohydrates for regeneration, the other does not. It is possible that direct combinaton between the two groups occurs with the co-operation of carbohydrates. At least Schulze's conclusion, that the carbohydrates *promote* the reconstruction of albumin from the secondary nitrogenous compounds, seems safely acceptable in the light of our present knowledge.

[31] Landwirthschaft. Jahrbüch, vol. 9 (1880), p. 731.

Undescribed plants from Guatemala. I.

JOHN DONNELL SMITH.

VOCHYSIA GUATEMALENSIS. (Series *Lutescentes*, Warm., Fl. Brasil. xiii.[2] 59.)—Smooth and shining except the puberulous leaf-buds, stipules, rachises and calyx-lobes: purplish branchlets costate-angled by a decurrent line from each stipule, interpetiolar sides concave: stipules persistent, subulate, 1½ lines long with an acute canescent tip; petioles an inch long; leaves 3–4-verticillate, opposite, or uppermost rarely alternate, oblong-lanceolate, acuminate at each end, 5–6 inches long, less than a third as broad: thyrsi composing leafy panicles, terminal and from upper axils, cylindrical, 4–7 inches long, rachis angulate and sulcate; cicinni approximate, 3–4-flowered, mostly about an inch long without the flowers, peduncles and short pedicels suberect and triquetrous: flower-buds linear, scarcely 1½ lines broad, slightly recurved, acuminate; calyx sparsely dotted with red glands, anterior lobes broadly ovate and a line long, lateral ones rounder and smaller, posterior lobe 8–10 lines long and reflexed-patent after anthesis with its slender terete deflexed spur half as long as calyx; petals oblong-obovate, the anterior one half as long as calyx and 2 lines broad, the others a little shorter and much narrower; stamen linear-spatulate, nearly twice longer than petals, the 5-lines-long and 1-line-broad anther narrowing at base into the tapering filament; staminodes tipped with a red gland; style not thickened above; stigma minute; capsule (immature) oblong, thrice longer than broad, obtusely trigonal.—Leaves nearly of *V. magnifica* Warm., but longer-acuminate, mucronulate, costal arches less distinct, reticulation more minute, and stipules conspicuous for the series; distinguished better by floral characters.—A lofty tree, not rare in its locality, with vast panicles of shining-yellow flowers, discovered by Mr. H. von Türckheim in the mountain-forests of Pansamala, Dept. Alta Vera Paz, altitude 3,800 feet, June, 1886. (Plantæ Guatemalenses Tuerckheimianæ, a John Donnell Smith editæ, 943.[1]) Remarkable as the only species of a large genus, and with a single exception the only representative of its order, that has been found outside of South America.

[1] Sets of this series of plants are in course of preparation for distribution to Gray Herb., Harvard University; Torrey Herb., Columbia College; National Herb., Washington; Kew Herb., London; Muséum d'hist. nat. de Paris; Königl. botanisches Museum, Berlin.

HAMELIA CALYCOSA.—A shrub 9–12 feet high, glabrate: stipules filiform, 2 lines long, with a ciliated interpetiolar line: leaves ternate, lanceolate, 2–4 inches long, one fourth as broad, acuminately produced, finely attenuated into a short pubescent petiole, margins revolute, punctate and with scattered cystoliths, veins not reticulate: cymes pubescent, compound, trichotomous, umbelliform; lobes of turbinate calyx linear to oblong, 2½ lines long and equalling the tube, sinuses truncate; corolla yellow, ventricose-campanulate, 12–14 lines long, narrowed below into a cylindrical tube 3 lines long; anthers mucronately produced at base, four times longer than the complanate filament; stigma about equalling style; capsules glabrate, elliptical, 10-costate, 5 lines long, half as broad.—Resembling *H. ventricosa* Sw., but flowers differing by the calyx-lobes large for the genus, short broad filaments, and long stigma.—Pansamala, alt. 3,800 feet, June, 1885. (Pl. Guat. Tuerckh., a I. D. S. edit., 454.—De Türckh. Fl. Guat. Edit. Keck 454.)

ARDISIA PECTINATA.—Arboreous: branchlets knotted, warty, pitted with large scars of fallen petioles: leaves crowded at end of branchlets, pergameneous, pellucid, nitidous, oblong to oblanceolate, 10–13 inches long, 4–5 inches broad, abruptly short-acuminate, cuneately narrowed to a channeled petiole half an inch long, margins finely pectinate throughout by excurrent nerves, lineolate-glandulose beneath, reticulately veined, with free veinlets, the 20–22 stronger lateral costæ joining in two series of conspicuous arches and a less distinct marginal one: panicle terminal, nearly sessile, ferruginous pubescent, broadly pyramidal, about equaling the leaves, rachises angulate and sulcate, 5-merous flowers subumbellately racemose at the end of tertiary branches, linear-bracted spreading pedicels 4 lines long: calyx-lobes ovate, 1 line long, 4-nerved, ocellate and at length glandular-thickened beneath, margins scariose; corolla-segments rose-colored, broadly ovate-lanceolate, obtuse, 2½ lines long, reflexed, 4-nerved, corrugate above, margins scariose and undulate, æstivation dextrorsely convolute and contorted; stamens two-thirds as long as corolla, oblong apiculate anthers thrice longer than filament, connective not dilated above, cells dehiscing by elliptical apical pores one-fourth their length; style straight, flat tapering, a little exceeding the stamens; ovary ovoid, rubro-punctate, 15–20-ovulate.—Related to *A. pellucida* Œrst. as described without

flowers.—Forests of Pansamala, alt. 3,800 feet, June, 1886. (Pl. Guat. Tuerck., a I. D. S. edit., 942.)

MYRIOCARPA HETEROSPICATA.—Monœcious: a shrub with pale smooth verrucose branches: leaves glabrate except the ciliate veins and axils of under surface, lanceolate-acuminate, 3–5 inches long, less than a third as broad, narrowed to a pubescent petiole 10–16 lines long, margins entire or with a few callose points, tri- or tripli-nerved with 2–3 pairs above the middle, loosely reticulate beneath, above conspicuously beset with cystoliths not radiately arranged: spikes unisexual, approximate, single in the axils, secund, forking once shortly above the peduncle, the closely-flowered staminate spike about a third as long as the loosely-flowered 6–9-inches-long pistillate one: male flowers 4-merous, perianth-segments roundish and marked with cystoliths, rudiment of ovary indistinct and peltate; female flower sessile in a 2-phyllous calycle.—Distinct by its spikes not androgynous as in the only other monœcious species, *M. bifurca* Liebm. The absence of both hairs and glands, as radiating points for cystoliths, is also special.—Forests of Pansamala, alt. 3,800 feet, March, 1886. (Pl. Guat. Tuerck., a I. D. S. edit., 892.)

NEPHRODIUM TUERCKHEIMII.—Rhizome stout, creeping, forking: stipes loosely clustered, ascending at base, 2–2½ feet long, a third of an inch thick, stramineous, pubescent, densely clothed throughout with brown triangular-lanceolate patent scales 3–4 lines long with a punctiform cellulation: frond oblong-acuminate, 3–4 feet long, half as broad, subcoriaceous, strigillose or glabrate above, paler and pilose beneath; main rachis thickly paleaceous, secondary ones with smaller scattered scales; pinnæ closely 35–40-jugate below the pinnatifid apex, linear-tapering, the lower ones not reduced, 16–20 lines broad, cut down to within a sixth of the space to the midrib; segments 60–70-jugate, linear-oblong, 8 lines long, 2 lines broad, oblique, acutish, margins revolute, veins 18–20-jugate with the lowest one terminating at the sinus; basal segments of lower pinnæ enlarged to 17 lines long and 8 lines broad, ovate-lanceolate, pinnatifid: sori submarginal, small, 9–12 to the series, persistent indusium reniform and hirsute.—Allied to *N. patens* Desv., and especially to the var. *stipulare* Bak. (*Aspidium stipulare* Willd.), but differing by the chaffy stipe and rachises, deeply cut pinnæ, numerous segments and veinlets with sori nearer

the margin.—Swamps near Coban, Alta Vera Paz, alt. 4,300 feet, September, 1885. (Pl.Guat.Tuerck.,a I. D. S.edit., 704.)

NEPHRODIUM FENDLERI, Hook., var. PAUCIPINNATUM.—Rhizome short, thick, erect; scales matted, blackish, lanceolate, 4–5 lines long, cells punctiform; rootlets with a heavy brown tomentum: stipes few in the crown, scaly at base, smooth, stramineous, 2 feet long, thick as a crow's quill: frond about as long as stipe, quite smooth throughout, minutely bullate-punctate; pinnæ 8–14, not in pairs, 8–10 inches long, 15–20 lines broad, terminal one distinct and not larger than the lateral, caudate entire apex 2 inches long, cut almost half-way to the rachis into 20–24 lobes; veinlets 10–12-jugate, only two or three from adjoining groups uniting at or below the sinus; sori on each veinlet, those above the sinus marginal; indusium pallid, not corrugate, reniform, center depressed, sinus open.—Prof. Eaton has examined this fern, and advises that it comes very close to his *Aspidium Fendleri* (Mem. Ac. Sc. viii. 210), but has fewer pinnæ. In that respect as well as others the numerous specimens are uniform.—Rock-crevices in Petet, near Coban, alt. 4,300 feet, September, 1885; copses, Pansamala, alt. 3,800 feet, July, 1886. (Pl. Guat. Tuerck., a I. D. S. edit., 767, 667.)

Notes on Umbelliferæ of E. United States. V.

JOHN M. COULTER AND J. N. ROSE.

(WITH PLATE V.)

[In addition to the collections mentioned in the April GAZETTE, we have now to add those belonging to Brown University. Prof. W. W. Bailey has thus kindly put at our disposal, not only his own large collection of Umbelliferæ, but also those of Olney and Bennett.]

THASPIUM Nutt.—Fruit ovoid to oblong, slightly flattened dorsally: carpel with 5 primary ribs, 3 or 4 or all of them strongly winged: oil-ducts solitary in the intervals, two on the commissural side: seed-section round or somewhat dorsally flattened, indented beneath the oil-ducts: stylopodium wanting; styles long (figs. 57–62).—Perennials (2 to 5 ft. high), with ternately divided leaves and broad serrate or toothed leaflets (or lower leaves simple), mostly yellow flowers, and all the fruit pedicelled.--The species of Thaspium are in great confusion. In Gray's Manual *T. aureum* Nutt. and

T. trifoliatum Gray each have an apterous variety. These apterous forms were taken from Koch's genus Zizia and placed under the Thaspium species apparently from the close resemblance of the foliage. The fruit characters, however, are abundantly distinct, for the Zizia forms have simply ribbed fruit flattened laterally, the central fruit of the umbellets sessile, and flower early in spring; while T. aureum and T. trifoliatum of the Manual have winged fruit flattened dorsally, central fruit pedicelled, and flower late in summer, maturing fruit in the fall. Bentham and Hooker have transferred these apterous Zizia forms to a section Zizia under Carum, from which genus they differ in the absence of stylopodia, central sessile fruit, more prominent ribs, and Thaspium-like foliage. The same authors seem to have made no disposition of T. aureum of the Manual, unless it went with the apterous variety, while the group of forms under *T. trifoliatum* Gray of the Manual has been taken as representing *T. cordatum* Torr. & Gray. For this latter species Bentham and Hooker seem to have had in mind only Gray's apterous variety, and so referred it to Carum § Zizia as one of the two species. In Watson's Bibliographical Index the synonym *Carum cordatum* Benth. & Hook., under T. trifoliatum, is correctly quoted, so far as literature is concerned, but apparently should be transferred to *T. trifoliatum*, var. *apterum* Gray, to express the real form Bentham and Hooker had in mind. This leaves the Manual forms T. aureum and T. trifoliatum with its var. atropurpureum unprovided for by these authors, the two apterous varieties only having been used to form the section Zizia under Carum. An explanation of this may be found in the fact that most of the herbarium specimens labeled Thaspium aureum and T. trifoliatum are really the so-called apterous varieties. The specific forms with winged fruit are quite uncommon among herbarium specimens, while the apterous forms are very abundant.

1. **T. aureum** Nutt. Genera, i. 196. Glabrous: root-leaves mostly cordate, serrate; stem-leaves simply ternate (rarely biternate); leaflets ovate to lanceolate, round or tapering at base, serrate: flowers deep yellow: fruit globose-ovoid, about 2 lines long, all the ribs equally winged (figs. 57, 58).—Thickets and woodlands, as far west as Illinois. Flowering in summer and maturing fruit in late summer or autumn. This species has a wide range of variation in the division and toothing of its leaves, but they are so inconstant that it seems impossible to found specific distinctions upon them.

In characterizing T. aureum, Nuttall has laid some stress upon "lateral divisions of the upper leaves subsessile," a character which means nothing, as these divisions may be sessile, subsessile, or petioled on the same plant, either in T. aureum or the T. trifoliatum of Gray. So far as foliage characters are concerned, serrate leaflets point to Nuttall's form, while crenately toothed leaflets stand for Gray's T. trifoliatum, exclusive of his vars. apterum and atropurpureum.

Further confusion in leaf characters has arisen by including the so-called apterous varieties, which we have transferred to Zizia. An extreme variation in leaf characters, but merging completely into the type through intermediate forms, is presented by

Var. **trifoliatum,** in which all the leaves or leaflets are crenate or crenately toothed. *T. trifoliatum* Gray, Manual, 195, in part.—Ohio to Illinois and westward to Oregon. This seems to be the common western form of the species, as our Pacific coast specimens are all distinctly var. trifoliatum. From Ohio to Illinois there is an interminable intermixing of the species and the variety, while in Pennsylvania the specific form is well represented.

Var. **atropurpureum.** Petals dark-purple. *T. atropurpureum* Nutt. *T. trifoliatum* var. *atropurpureum* Gray, Manual.—With the preceding forms. This variety has the leaf characters of the species, and if var. trifoliatum had been retained as a species, var. atropurpureum would have been transferred to T. aureum.

In giving the range of the above group of forms it has been impossible to use published ranges owing to the great confusion as to what forms were intended. Discarding the apterous varieties, the true Thaspiums of this group are but scantily represented in our herbaria, far more so, probably, than their occurrence would justify. The early spring and summer flowers and fruits of the apterous forms have probably too often satisfied collectors that they had already secured good material of forms which only appeared in collecting condition in late summer and autumn. Therefore we could only cite such range as our material indicated, confident at the same time that it could not represent the whole range. We would call the attention of collectors to this point, that the true range of T. aureum and its var. trifoliatum may be obtained.

2. **T. barbinode** Nutt. Genera, i. 196. Loosely branched, pubescent on the joints, sometimes puberulent in the umbels:

leaves 1 to 3-ternate; leaflets ovate to lanceolate, acute, with cuneate base, coarsely cut-serrate, often ternately cleft or parted: flowers light yellow: fruit broadly oblong, about 3 lines long and 2 lines broad, with mostly 7 ribs prominently winged, the other three not at all winged or but slightly so (figs. 59, 60).—Banks of streams, New York to Minnesota and southward. Fl. May and June.

Var. **angustifolia** has narrower, more sharply cut leaflets, and is readily distinguished from the type.—Marion Co., Illinois (*Bebb*), Westmoreland Co., Pennsylvania (*W. W. Bailey*), Montgomery Co., Indiana (*Rose*).

3. **T. Walteri** Shuttlew. Loosely branched, pubescent on the joints, puberulent on branchlets, umbels, and fruit, with fewer leaves: leaves 1 to 3-ternate: leaflets 1 to 2-pinnatifid, lobes linear or oblong, one or two leaves near the base often very large and long petioled (petioles sometimes a foot long): flowers light yellow: fruit oblong, 1½ to 2½ lines long and 1 to 1½ lines broad, all the ribs winged, generally three of them narrowly so (figs. 61, 62). *T. pinnatifidum* Gray, Manual.—Barrens and mountains, North Carolina to Kentucky.

ZIZIA[1] Koch.—Fruit ovate to oblong, flattened laterally: carpel with 5 primary ribs (not at all winged): oil-ducts large, solitary in the intervals, two on the commissural side, and a small one in each rib: seed-section round, indented beneath the oil-ducts: stylopodium wanting; styles long (figs. 63–66).—Smooth perennials (1 to 3 ft. high), with mostly Thaspium-like leaves, yellow flowers, and central fruit of each umbellet sessile (in ours). Flowers in early spring, in open prairies and upland meadows.

In separating the species of Zizia from the Thaspium aureum group we are very much indebted to Mr. M. S. Bebb, who has placed the careful observations of ten years at our disposal, and who is convinced that they are abundantly distinct. His field observations concerning their decided differences in habitat and time of blooming very strongly confirm the differences discovered in fruit structure.[2]

1. **Z. aurea** Koch, Umbel. 129. Radical leaves very long-petioled, all but the uppermost leaves 2–3-ternate; leaflets ovate to lanceolate, sharply serrate: rays 15 to 25, stout, 1 or

[1] It must be remembered that the Zizia of Gray's Manual is a Pimpinella.

[2] The western species that has been variously called Seseli Hallii, Musenium Greenei, and Carum (?) Hallii is evidently a Zizia. Its fruit characters are identical with those of Zizia, and had Koch's genus been retained it would probably have already included this species as Zizia Hallii.

2 inches long: fruit oblong, about 2 lines long (figs. 63, 64). *Thaspium aureum* Nutt., var. *apterum* Gray, Manual, 195. *Carum aureum* Benth. & Hook. Gen. Pl. i. 891.—Throughout our range, extending westward as far as the Saskatchewan and Texas.—Although Thaspium aureum, var. apterum is the real synonym of this species, botanists will find in their herbaria many specimens of Zizia aurea labeled Thaspium aureum and Thaspium trifoliatum.

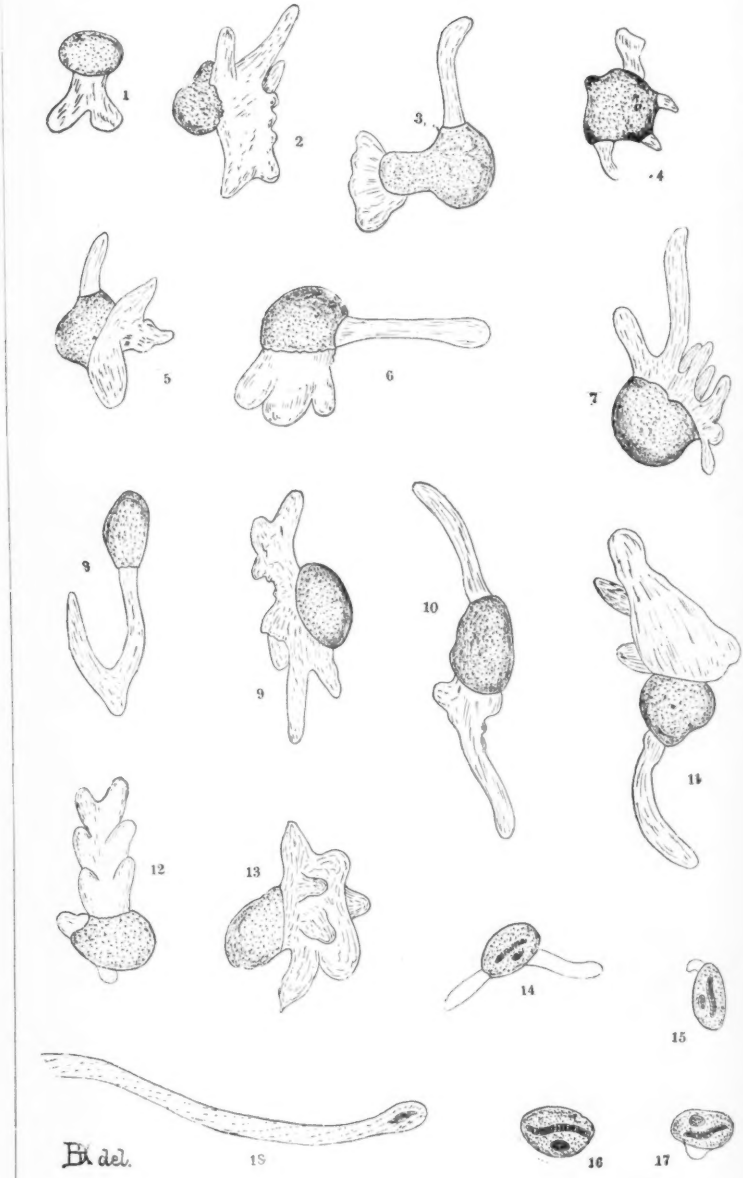
Var. **Bebbii.** A more slender, mountain form, with leaflets more coarsely serrate or even toothed, the radical leaves smaller and more simple: rays 2 to 8, slender, 2 or 3 inches long: fruit mostly smaller, oval, 1 to 1½ lines long.—Virginia and North Carolina. Collected by *Curtiss* (1868), *Canby* (1876), *Meehan*, *Porter*, *Leidy* and *Willcox* (1880).

2. **Z. cordata** Koch, Umbel. 129. Radical leaves mostly long-petioled, cordate or even rounder, crenately toothed, very rarely lobed or divided; stem-leaves simply ternate or quinate, ovate to lanceolate, simply serrate, incised, or even parted: fruit ovate, 1½ lines long; seed-section larger than inthe last (figs. 65, 66). *Thaspium trifoliatum*, var. *apter um* Gray, Manual, 195. *Carum cordatum* Benth. & Hook. Gen. Pl. i. 891.—Same range as last and extending to Oregon. As in the last species, herbarium specimens of Zizia cordata will be found labeled almost anything under the Thaspium aureum section.

CARUM L.—Fruit ovate to oblong, flattened laterally: carpel with 5 primary ribs: oil-ducts large, solitary in the intervals, 2 to 6 on the commissural side, none in the ribs: seed-section dorsally flattened, more or less indented beneath the oil-ducts: stylopodium conical (figs. 67, 68).—The American species are western, with tuberous or fusiform roots, simply pinnate leaves with linear leaflets, and white flowers. The common garden caraway from Europe seems to have become naturalized in many places, and is

1. **C. Carui** L., with pinnately compound leaves and filiform divisions.—Apparently more commonly naturalized to the north and northwest.

EXPLANATION OF PLATE V.—Fig. 57, fruit of Thaspium aureum; fig. 58, section of carpel of same; fig. 59, fruit of T. barbinode; fig. 60, section of fruit of same; fig. 61, fruit of T. Walteri; fig. 62, section of fruit of same; fig. 63, fruit of Zizia aurea; fig. 64, section of carpel of same; fig. 65, fruit of Z. cordata; fig. 66, section of carpel of same; fig. 67, fruit of Carum Carui; fig. 68, section of carpel of same. All surface views are × 7; transverse sections × 22.



HALSTED on POLLEN TUBES.

BRIEFER ARTICLES.

"Crazy" pollen of the bell-wort (with plate VI.)—The pollen of the great-flowered bell-wort (*Uvularia grandiflora* Sm.) is of good size, smooth coated, nearly colorless (yellow in mass) and in many ways well adapted for use in laboratory work with students. The two nuclei may be easily demonstrated by using methyl violet or methyl green. The best reagent, however, out of a large number employed, is azo-rubin when used in a very dilute solution. Picric acid brings out the smaller nucleus in a very satisfactory manner. The larger nucleus is nearly as long as the pollen grain (55μ–65μ) and usually occupies its center. The appearance of the pollen after treatment is shown in figures 14-17, plate VI. The larger nucleus is many times longer than broad, and somewhat bent and pointed at each end. The smaller nucleus is oval shaped and not more than one-eighth as large as the long nucleus. It occupies a nearly central position in the pollen grain,

These Uvularia pollen grains germinate quickly in a medium sugar solution and exhibit a fine circulation of protoplasm within the larger tubes. In germination a tube arises seemingly at any point upon the surface of the grain. It as frequently grows from the side as from the end, and occasionally there are two tubes from the same grain when growing under ordinary conditions (figures 14, 15 and 17). Large numbers of pollen grains were found with tubes a millimetre in length when first removed from the anthers. It was therefore not necessary to wait upon the cultures for a supply of germinating pollen. In the culture medium some tubes obtained a length of two millimetres in fifteen hours. In many instances the large nucleus was found in the tube, and in one case it was in the somewhat enlarged tips of the tube. A portion of the end of a pollen tube is shown in figure 18. The granular contents of the tubes were arranged in well-defined rows which occupied a somewhat spiral direction beneath the wall of the tube. The protoplasm in its motion observed the same direction, and reminded the observers of what is to be seen within the long cells of a Nitella. The granules could be followed to the enlarged tip of the tube, where they passed by the nucleus upon one side and turned and returned upon the opposite side. The cyclosis was quite rapid, and it is to be regretted that measurements of the movements of the granules were not recorded.

One of the culture slides lost a large part of the nourishing sugar solution by absorption into the pieces of surrounding blotting paper, and the pollen grains upon the under surface of the suspended glass cover produced tubes of very strange abnormal forms. The germination of a dozen such grains is shown in figures 1-13. These grains were selected from among hundreds of others as exhibiting the more extraordinary

forms. The original grain in each case is indicated by a darker or dotted shading, while the outgrowth is shown as a less colored portion. It will be seen at a glance that there was seemingly no "method in their madness." Some germinate from the side, others from the end, while others still send out tubes from both side and end. In some cases the remnant of the pollen grain is like a shell that is found upon the back of a snail, while the irregular growth of short tubes resembles the living portion of the snail. In some instances the pollen grain looked as if it had undergone a process similar to that of the popping open of a grain of corn. In others there was an amœba-like mass, projecting from one side of the grain, having not less than a dozen arms extending in as many directions. In one case there is shown a grain with a broad zigzag extending band, as if the point of growth had changed alternately from right to left as the tube increased in length. It is doubtless true that the projecting pollen tube in each of the abnormal cases met with more than usual resistance and the place of growth was shifted to another part of the tube. In this way, by the increase in size taking place at points of least resistance, each pollen grain built up a structure peculiar to itself, determined by its surroundings. It is not entirely unlike the formation of irregular, lifeless structures when liquids undergo solidification or even crystallization under unfavorable circumstances.

These unfortunate Uvularia pollen grains teach us of the persistency that is inherent in these highly vitalized cells. After successive failures to develop long tubes they still boldly attempted to send out new ones until they perished victims of adverse environments.—Byron D. Halsted

EDITORIAL.

In the subject of botany this seems to be an era of text-books and laboratory guides. Never before have so many authors essayed to satisfy the demands of the student and teacher, and never before have students and teachers looked so eagerly for some book to suit their needs. The harvest of books is large, but the quality is of all grades. The publication of worthless botanical text-books is often deprecated, but it is not a serious evil, except to the publishers. No text-book in these days can be otherwise than short-lived which does not "fill the want" it proposes to, and in no other department is the working of the law of natural selection more apparent than in that of text-books. There is a class of botanists who are never satisfied until they write a book. With no disposition to add something to the sum of botanical knowledge by patient work (they call it lack of opportunity), they conceive that the easiest thing to do is to grind over the knowledge of others and make a text-book. If there is anything that requires complete mastery of the subject of botany, a keen and critical judgment, a happy method of thought and expression, it is to write a text-book that will live. The young worker begins by readjusting clas-

sification, and the young writer by preparing a text-book, both of which attempts require the most mature judgment backed by the fullest experience. And so we must continue to have a perennial supply of these attempts: some will do good, none will do serious harm; and any of them may serve to introduce a working botanist whose subsequent performance will atone for the crudity of his first appearance. The day of the well-nigh universal use of any text-book is probably past, for there is such a diversity of opinion concerning methods of presentation that there must needs be text-books equally diverse. Besides, text-books are becoming more and more books of reference for library rather than class-room use. However, the high schools, and colleges of equal rank in botanical equipment, are clamoring for a text-book, or rather the botanists are telling them that they need one. Several attempts have been made to supply this demand, but the failures may be grouped under four heads: (1). Some have attempted too much, apparently lacking the power of judicious omission, and the book is so bulky and technical that the untrained teacher (and they are mostly untrained in the high schools) will never attempt it but once. The authors of these books have kept an eye on the criticism of fellow botanists rather than the need of high school classes, and have feared if they omitted anything they might be accused of not knowing it. We fear that the hypercriticism indulged in by some of our leading scientific journals has developed this spirit. For it is their custom to pass over the whole well-constructed bulk of the book to condemn some little detail which more than likely holds no relation to the general purpose. (2). Others have gone to the opposite extreme, and having young pupils constantly in mind, have endeavored to attract and simplify at the expense of accuracy, a method that should be heartily condemned. (3). A third class of books, worse than either of the former, are those that treat the science of botany as a vocabulary of scientific terms. A full and illustrated glossary is not a botanical text-book, and the attempt to use it as such is to bring discredit upon botany. (4). A lack in all our recent text-books, which is against a long life, is the lack of a manual for the determination of plants. Modern methods may claim that we do not want to "analyze" plants, but we do and we always will, and it will remain the chief means of exciting a living interest in the subject of botany. Hence that modern text-book only can be a permanent success which combines with it a manual, and a manual is no easy thing to prepare. When a book can be prepared technically accurate and full enough for scientific botanists, elementary enough for beginners, perfectly easy for untrained teachers to use, suggestive enough for the experienced worker, large enough to contain all the science of botany and a manual, small enough to be completed in a term of twelve weeks and sell for a dollar or two, then will every one commend it as the book to "fill a felt want;" but the man who can accomplish this must be one who speaks "as never man spake."

OPEN LETTERS.

Humblebees and Rhododendron nudiflorum.

In the April number of the BOTANICAL GAZETTE, mention is made by Gilbert van Ingen of the manner in which humblebees extract honey from Petunias. A similar instance has been presented to my attention in the case of Rhododendron nudiflorum. The humblebees uniformly alighted upon the limb of the corolla, and, crawling along the upper or inner side of the tube nearly to the calyx, punctured the corolla just above the ovary, and through the hole thus made, extracted the nectar. During the time I observed them, none attempted to obtain the honey in the legitimate method. To such an extent had these marauders carried their ravages, that it was with difficulty that a fully opened flower could be found on the whole bush that was not punctured. At the same time, however, several lepidoptera were observed extracting the nectar in the legitimate manner.

E. R. MEMMINGER.

Flat Rock, N. C.

Autumnal blooming of Oxalis.

I have just read (in the May GAZETTE) Professor Thomson's account of the autumnal blooming of Oxalis. I observed the same thing in an entirely undisturbed locality. Between Silesia and Crystal City, in Jefferson county, Mo., there is a sandy rock about two miles in length, and in its crevices this Oxalis was blooming, but without leaves. And curious enough the flowers were mostly white, so that at first I thought I had found a new species. I also found on the top of the rock Allium striatum blooming a second time, but when I went this year (in May) to the place I did not find many plants blooming. Last year we had a very dry summer, and in the fall good rains, and this, I think, will account for the autumnal blooming of these plants.

HENRY EGGERT.

St. Louis, Mo.

Letter to Botanical Club of A. A. A. S.

At the 36th meeting, to be held August 10–17 in New York City, the members of the Botanical Club will be entertained by the Torrey Club, and all pains taken to make the session memorable to both. The plans for entertainment have not yet been completed, but with the many places of interest in the vicinity of New York it is certain that the meeting can be made profitable to the botanists of the Association. Collections of plants from the vicinity are being made for distribution to the members, and it is proposed to give them an opportunity to collect fresh specimens. Arrangements are being made for receptions to promote social intercourse and mutual acquaintance, and a special effort will be made to present as many papers and matters of botanical interest as time will permit.

ELIZABETH G. BRITTON,

New York City. *Secretary of Botanical Club.*

CURRENT LITERATURE.

An Introduction to the Study of Lichens. By Henry Willey. 72 pp. and 10 plates. Printed for the author, New Bedford, Mass.

No more competent lichenologist could have been found in this country, since the death of Professor Tuckerman, to prepare this introduction to the study of lichens. It is a group beset with great difficulties, and hence discouragements, for the beginner, and this must account, to some extent, for the limited number of lichen students in this country. Mr. Willey has thus done good work in exactly the direction it was needed, and under the guidance and stimulus of this simple introduction the way into this department has been made as easy as was possible. There are six chapters, with the following subjects: On collecting and mounting lichens; The lichen, its structure and organs; The distribution, etc., of North American lichens; The history of lichens; Helps to the study of lichens; and Arrangement of North American lichens. Then follows a supplement giving a list of the names of all published lichens. The ten plates display the structures of the thallus, gonidia, apothecia, spermagones, and pycnides, and end with illustrations of the spores of all the seventy-six genera. We mistake the effect of this pamphlet greatly if it does not very much stimulate the study of this difficult and interesting group in this country. It can be procured from the author for $1.

Die natürlichen Pflanzenfamilien, nebst ihren Gattungen und wichtigeren Arten insbesondere den Nutzpflanzen, bearbeitet unter Mitwirkung zahlreicher hervorragender Fachgelehrten, von A. Engler und K. Prantl. Royal, 8°. Leipzig: Wilhelm Engelmann.

The first two fascicles of this important work are at hand. Each fascicle is to consist of 48 pp., and it is expected that about sixteen parts will appear yearly, which will complete the work in six or seven years. The first part is to embrace the Cryptogams, and is under the supervision of Dr. Prantl. The second to the fifth parts include the Phanerogams, edited by Dr. Engler. The list of collaborators is very large, and embraces the most eminent German botanists.

The first two fascicles of Part II. treat of Palmæ, by O. Drude (already noticed in this journal, p. 89); Juncaceæ, by Fr. Buchenau; Stemonaceæ and Liliaceæ (in part), by A. Engler. The treatment of each order is very comprehensive. For example, the topics treated under the Liliaceæ are: the most important literature; characteristics; organs of vegetation; anatomy; arrangement and growth of flowers; pollination; fruit and seeds; geographical distribution; affinities; and classification. The latter includes an account of each tribe and genus, with remarks on the principal species. The work is liberally and admirably illustrated. The ninety-six pages now published contain 564 single figures! The very low

subscription price for each fascicle (M. 1.50=35c) makes this one of the cheapest, as it promises to be one of the best, botanical works ever published. It strikes us as unfortunate, however, that the fascicles should be separately paged.

NOTES AND NEWS.

DR. STERNBERG has gone to Rio de Janeiro to investigate yellow fever.

MENYANTHES TRIFOLIATA turns up in Rhode Island this year with trimerous and tetramerous flowers in one raceme.

THE YEARLY increase of cork is said by Gerber to vary from one row of cells in Salix to one hundred rows in Quercus suber.

HARDWICKE'S *Science Gossip* for May has a very interesting description of Australian forests by the editor, Dr. J. E. Taylor.

MANY new and interesting species are being discovered in the Philippine Islands by Dr. Sebastian Vidal, Director of the Botanic Garden at Manilla.

THE catalogue of Rhode Island plants, by Mr. James L. Bennett, is to be published by the Providence Franklin Society, and is understood to be in press.

DR. THEOBALD SMITH, of the Bureau of Animal Industry, Washington, D. C., has just closed a course of six lectures on bacteria before Cornell University.

THE May number of *The Microscope* contains "Staining and mounting plant sections," by C. Wellington, and "The movement of diatoms," by Cornelius Onderdonk.

THE CHEMICAL relations of bacteria is the title of a long and interesting article by Dr. Charles E. Fairman, of Lyndonville, N. Y., printed in the *Medical Register* (Phila.) of April 27.

DR. MANLY MILES has an article in *Agricultural Science* for May on the microbes of nitrification, based upon cultures and experiments which he has been prosecuting for some time.

PROF. BESSEY, in the *American Naturalist* for April, has done a capital thing for botanical students in publishing a list of the best and most accessible manuals in the various groups of plants.

THE Linnean Society has recently elected the following foreign members: Dr. George A. Schweinfurth, Cairo, Egypt; Count H. Solms-Laubach, University of Göttingen; Dr. Melchior Treub, Buitenzorg, Java.

THE SPECIES of Peronosporeæ found in Scotland, are enumerated by Dr. J. W. H. Trail in the *Scottish Naturalist* for April. The list gives 1 Pythium, 3 Cystopus, 1 Phytophthora, and 24 Peronospora, being eleven less than the United States' list, published by Dr. Farlow in this Journal, 1884-5.

A HAND-BOOK of the other orders of vascular cryptogams, by Mr. J. G. Baker, is announced in continuation of Hooker & Baker's "Synopsis Filicum." It will include Equisetaceæ, Lycopodiaceæ, Selaginellaceæ and Rhizocarpeæ, in which there are eleven genera and about seven hundred species.

THE FOLLOWING corrections should be made on page 101 of this volume: line 2, for "Tamisconato" read "Temisconata"; line 4, for "form" read "from"; line 8 from bottom, place a semicolon after "probable" and dele the comma after "likely."

A DOZEN years ago Vogel and Reischauer observed yellow crystals covering the outer coatings of walnuts, a substance found also in the expressed juice, and called by them nucine or juglon. And now Bernthsen and Semper have just built it up artificially—another instance of the synthesis of a natural product.

PROF. W. W. BAILEY writes that a lady pupil had brought him a spray of an apple-tree with peculiarly monstrous flowers. The petals were aborted and green, and there were no stamens. The carpels, with style and stigma, were fairly well developed. The tree is reported to bear fruit from these curious flowers.

A COURSE of botanical lectures by Rev. F. D. Kelsey, illustrated with crayon drawings by F. W. Anderson, has just been given before the high school at Helena, Montana, and is to be repeated during June before the College of Montana at Deer Lodge. This is the first instruction of the kind given in the territory.

AT THE celebration of the seventieth birthday (March 30) of Professor C. von Naegeli, a present was made him of a basket filled with seventy different fruits, ornamented with seventy kinds of flowers, and surrounded by a garland composed of seventy plants, which belonged to as many different genera and species.

A BIBLIOGRAPHY of articles relating to North American fungi, by Drs Farlow and Trelease, is begun in the *Harvard University Bulletin* for May. It includes 338 numbers, and extends to and includes the first entry under H. A more extended notice of this important work will be given when the complete work is received.

THERE IS REASON to believe, according to Van Tieghem, that the forming branches of roots do not merely push aside the tissues of the main root, but actually absorb the cell-contents, and finally the cell-walls of these overlying tissues. We should expect some such action to accompany the mechanical pressure from the analogy in animal tissues.

A NEW Aroid, *Hydrosome Leopoldiana*, is described and figured by Dr. Masters, in *Gardener's Chronicle*, May 14. It is from the Congo country and has a remarkable spathe and spadix ("astonishing rather than beautiful," as Dr. Masters puts it). The very much divided leaves are three feet across and spread horizontally from a petiole two feet in length.

IN THE *American Garden* for May, Prof. L. H. Bailey, Jr., has defined for horticulturists six terms which are often confounded in their literature. The terms are acclimation, acclimatization, naturalization, domestication, hardiness and winter-killing. He also correctly remarks that "good English, considerately employed, is requisite to great advancement in horticultural literature.

A REALLY instructive teratological note in the *Bulletin* of the Botanical Society, of France, details the finding of specimens of Caltha palustris having two extra sepals within the usual ones which bore a row or two of apparent buds on their edges. M. Mangin investigated the structure of these buds and found that each possessed the structure of a perfect ovule, even to the egg-apparatus and antipodal cells!

PROF. HUXLEY recently read a paper before the Linnean Society on "The Gentians; Notes and Queries." He divides the Gentianeæ into two great series, characterized by the disposition of nectarial organs and a gradation of forms of the corolla from deeply-cleft rotate to funnel-form. The two series are called Perimelitæ and Mesomelitæ. He also considered their evolution and geographical distribution.

MR. J. KRUTTSCHNITT'S persistent assertion that the fecundation of the ovule by pollen tubes entering it was a myth has at last had attention in Europe, where Guignard, who has made himself famous by his investigation of fertilization, has studied Mr. Kruttschnitt's chief reliance, the genus Cereus. He finds fertilization, as was to be expected, accomplished in the usual way, through in C. tortuosus the pollen tubes may be as much as three weeks in reaching the ovules.

THE *Bulletin of the Torrey Botanical Club* for May contains "Notes on the American species of Marsilia," by L. M. Underwood and O. F. Cook. Five species are described: *M. polycarpa* Hook. & Grev., West Indies and South America; *M. quadrifolia* L., Connecticut, and cultivated elsewhere; *M. macropoda* Eng., Texas and New Mexico; *M. uncinata* A. Braun, Louisiana and Texas; *M. vestita* Hook. & Grev., widely distributed throughout the west, and extending into Mexico.

NOW COMES A. Meyer and denies *in toto* the Nägelian theory of the composition of the starch grain, viz: that it consists of two substances, granulose and starch-cellulose intermixed. He concludes from his researches that in ordinary starch, which turns blue with the iodine test, there is but one substance, and that it is alike throughout, the layered appearances being due to the varying porosity. Starch which turns red with the iodine test has other materials mixed with the true "starch-substance."

MR. DOUGLAS H. CAMPBELL has just completed his studies in the laboratory of Strasburger, and is now under Pfeffer at Tübingen. As a result of his work at Bonn, he has published in the *Bot. Gesellschaft* (March, 1877) a paper "On the development of spermatozoids." It is accompanied by a plate illustrating the subject in such groups as Gymnogramme, Alsophila, Adiantum, Pellia, Sphagnum, Salvinia. The results were obtained in the use of the very complete fixing and staining reagents in use by Dr. Strasburger, and which lie at the basis of so many of his astonishing results.

THE JOURNAL of the Royal Microscopical Society for April contains a valuable summary of the various contrivances, known as warm and cold stages, for keeping organisms at a given temperature while being studied under the microscope. The article is thoroughly illustrated and will be very helpful to any who wish to know what is the best thing to have in this line. Dr. Dallinger's thermostatic stage for the continuous observation of septic organisms is a most ingenious affair, without which the patient studies he has made on the life histories of these organisms would have been impossible.

DR. BYRON D. HALSTED has just issued a bulletin of the Iowa Agricultural College, showing the work done in the botanical department. It is one of the best we have ever seen, and represents an amount of good work done by the professor and his students that is really surprising. Part I. gives the result of work with the students. Some of the subjects reported on are as follows: Effects of drought upon grasses; Weeds on a square rod of ground; Largest and smallest leaves (Tilia and Picea nigra); Largest tree (white elm); Five worst weeds (Xanthium

strumarium, Ambrosia artemisiæfolia, Portulaca oleracea, Setaria glauca, and Bidens frondosa); Pigment cells of bloodroot; Young prothallus of Equisetum; a Study of pollen, etc. Part II. contains observations and experiments, treating of such subjects as germination of ergot from the wild rye, germination in red clover and timothy, is the cup-plant insectivorous?, observations on common thistle, pumpkin pegs, notes upon the Peronosporeæ for 1886, and several other groups of fungi, the "cedar apples," the Erysiphei, etc. This represents a very partial list of the subjects treated, and it will be inferred that the bulletin must represent the work of a very busy year.

MR. GEORGE E. DAVENPORT, of Medford, Mass., has just sent us a photograph of a complete set of Ophioglossaceæ for the United States, which he had put up for the Middlesex Institute. The specimens are shown just as they lie on the sheet, with diagrammatic notes and names. With a hand lens they may be studied in the photograph with a completeness only second to examining the specimens themselves. The photograph would be a very valuable thing to slip in among the Ophioglossaceæ of a herbarium to represent a type set. Mr. Davenport informs us that he can furnish copies to botanists for 35 cents.

DR. H. MOLISCH proposes[1] the following new test for sugar in plant sections: "A not too thin section laid on a slide is treated with a drop of 15-20 per cent. alcoholic solution of *a* naphthol; then two or three drops of concentrated H_2SO_4 are added. If the section contains sugar the violet coloration appears in less than two minutes. In other carbohydrates the color appears in a quarter to half an hour. In practice two sections are used; one of these is boiled for a few minutes in water, whereby sugar, dextrin, gum and glucosides are dissolved. The two sections are then submitted to the same test, and if sugar is present in the unboiled section, the coloration immediately appears. As dextrin, gum and glucosides may be usually disregarded, the appearance of the violet staining indicates, with great probability, the presence of sugar. The forgoing test may be used to demonstrate the presence of inulin, which, by Sachs' method, is liable to be confounded with sphæro-crystals, for these become immediately stained deep violet with *a* naphthol and sulphuric acid, and on the addition of thymol, are dissolved with the production of a red color."

MR. GEORGE MASSEE calls attention in the April number of the *Journal* of the Royal Microscopical Society, to the well-marked differentiation of a tissue for mechanical support in the stems and pileus of various species of Polyporus. It is especially striking in P. Pisochapani in the stem of which it forms a central hollow cylinder, composed of thick-walled hyphæ, eseptate and often polygonal in section. "At the apex of the stem this tube widens out into a funnel shaped body which becomes broken up into a number of ribs, radiating from the central portion to the margin of the pileus." The hyphæ of the other parts of the plant are very thin-walled and septate. There seemed to be no connection between the two sorts. "No member of the Agaricini, so far as I have been able to ascertain, shows such a marked division of labor amongst its component hyphæ for purposes of support." Mr. Massee also refers to the well-known laticiferous vessels of Lactarius and Russula, which contain glycogen and other substances. He affirms that the cystidia of the

[1] Sitzung-berichte der Königl. Akad. Wissen. Wien xciii (1886) pp. 912—23; fide Jour. Roy. Mic. Soc. April, 1887.

gill-bearing fungi are simply the terminal cells of laticiferous vessels, but can suggest no function for them unless the pouring out of their contents is for furnishing food to the developing spores, which, in many species, are bathed with it during growth.

THE FOLLOWING notice from Prof. W. W. Bailey in a Providence (R. I.) paper finds such an extensive application among botanists that we give it for their benefit. His experiences have evidently been the common ones of the fraternity, but his spirited rejoinder is not so common:

The writer esteems it a privilege, as he implied last summer, to answer any inquiries of a botanical nature which are within the range of his study. This always provided that the trusting public will thoughtfully remit the stamp or stamped envelope for the reply.

The announcement before made has resulted in an extensive correspondence, profitable we hope on both sides; we mean profitable in the sense of knowledge given or received. A teacher's work, especially in science, does not stop with the lecture-room. He is, or should be, the servant of the people, helping when he can, and owning up to ignorance when his knowledge fails him. It is from this diffidence only that we ever avoid an offered occupation.

It will aid very much in the work of the writer—save him, indeed from labor which it is sinful to thrust upon him—if people will only attend to the few following directions:

I. Collect plants both in flower and fruit, if possible. If herbaceous, take root and all, or, if too large, representative portions of root, stem, leaves, etc. Bend the plant into a Z or N, if necessary. Pare down the roots if too thick.

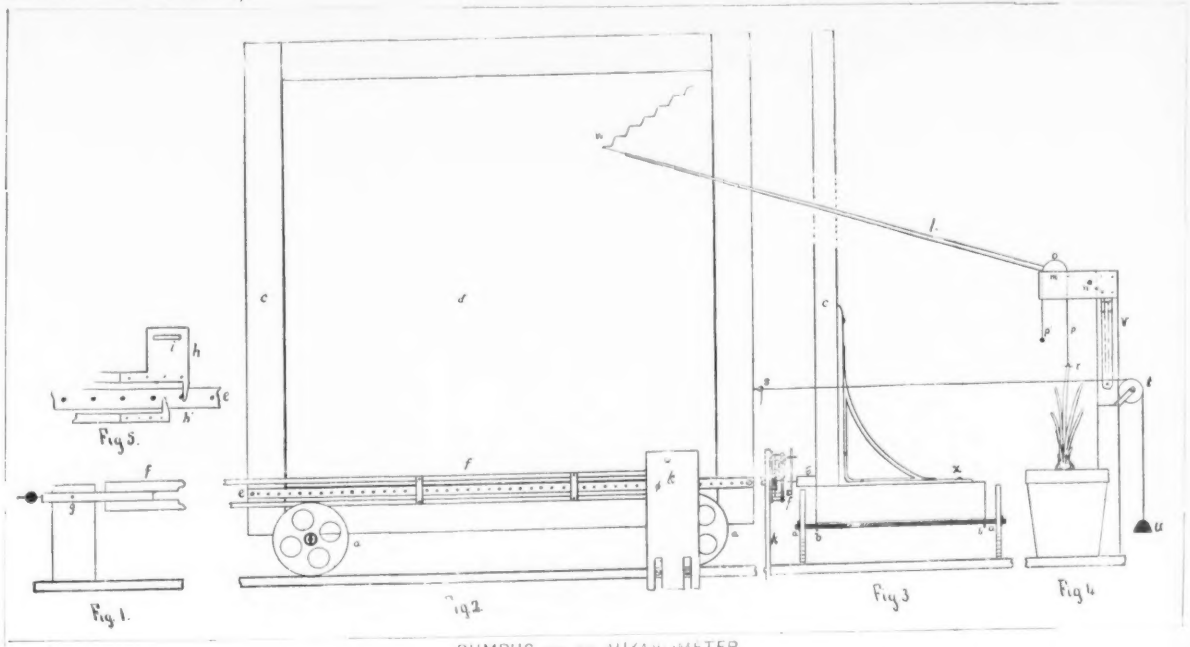
II. Do not snip off the tip end of a plant, even in flower, and send the cluster. Often a botanist can name such a fragment, but it is unfair to ask him. Moreover, it imperils his soul.

III. Tell by whom and where the plant was collected. A specimen unlocalized is worth next to nothing. It deserves to go into the waste-basket with poems on spring. The old curator has an underground railway for running such trash into the ash-heap.

IV. Don't think because a plant was collected at the tomb of Burns, or grew out of the rudder-hole of Noah's ark, that its botanical interest is at all enhanced. A good, well-collected plant from St. Helena is no better because it grew in the paths of Longwood. Sentiment is wholly apart from our special work. We often indulge it, but always with a Spanish rein.

V. Send the plants well pressed. Do not wrap them up in a wad, as if they were to be fired from a cannon.

VI. Trustingly believe that the writer, who here offers his service without price, is not so ferocious as his articles above denote.



BUMPUS on an AUXANOMETER.